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ABSTRACT

Designed to promote the use of safe, controlled investigations in science classrooms in Texas, this publication describes procedures to help teachers ensure the safety of all students in class and on field trips. Safety in the elementary science classroom and in secondary school science courses is discussed. Included are first-aid procedures, charts for safe storage of chemicals, and laboratory safety checklists. (Author/CS)

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FOREWORD

This publication is designed to promote the use of safe, controlled investigations in science classrooms in Texas.

Directed to science teachers and administrators, the publication describes procedures to help teachers ensure the safety of all students in class and on field trips. Safety in the elementary science classroom and in secondary school science courses is discussed. Included are first-aid procedures, charts for safe storage of chemicals, and laboratory safety checklists.

The publication was developed with the assistance of a committee of experienced science educators from Texas public schools and universities.

Alton O. Bowen
Commissioner of Education

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INTRODUCTION

Part of society's charge to education today is to prepare our youth to become responsible and productive members of society as well as to help them to cope successfully with everyday situations. Science is one area of the curriculum that is well suited to meet this charge.

Since the theme of science education is inquiry, all science courses in the public schools are to be laboratory oriented. A minimum of 40 percent of instructional time is to be devoted to student activities performed either individually or in small groups. This allotted time does not include demonstrations. (See Texas Education Agency Publication BU1 841 02, *Planning a Safe and Effective Learning Environment for Science,* pages 9, 15, 16, and 20.)

You, the science teacher, are challenged to provide laboratory instruction and are charged with the responsibility for supervising an accident-free learning environment. Even though students may need to use potentially dangerous chemicals and equipment in the laboratory, hazards can be reduced to a minimum. As part of laboratory activities, you should provide:

- a pre-laboratory discussion of the student investigation to be performed, of the potential dangers involved, and of the safety procedures and practices that will be followed
- constant supervision of the students during the laboratory activity to ensure a safe environment
- a post-laboratory discussion of the investigation with a review of the safety precautions taken

Operate from the premise that every accident is preventable. However, if an injury does occur, your prompt attention is to be focused on:

- removing the victim from further harm
- proceeding with appropriate emergency first aid
- reporting the incident to the school authorities

SAFETY AND THE LAW

The rapid accumulation of information in scientific fields has brought about increased desire and capability for a level of science laboratory instruction in Texas school districts that was undreamed of in past years. New knowledge has brought with it new methods of presenting ideas to students, resulting in increased excitement about science education.

A trend toward a more sophisticated society has accompanied the introduction of advancing scientific and technological materials and subjects into the curriculum. This society is demanding that you, the science teacher, accept an increased responsibility for the methods you use. Today, it is not uncommon for litigation to occur citing teachers for negligence. Negligence, broadly defined, usually consists of doing or failing to do something that results in an injury.

SAMPLE LAWSUITS

To describe what can happen in the event an incident should occur in your laboratory or on a field trip, a brief review of two lawsuits involving negligence follows:

- A chemistry laboratory activity directed the student to prepare and test an explosive. Instructions directed the student to separately grind with a mortar and pestle three powders. One of the students mixed and pulverized the three dry chemicals. As a result, an unexpected and violent explosion occurred, seriously injuring the student. The court ruled that the error was not unreasonable and that the student's mistake was not contributory negligence. (Although a student's actions may contribute to an accident, it may not be ruled to be unreasonable conduct, which would be necessary to establish contributory negligence.) The court ruled that it was not unreasonable to require the instructor to review the written procedures with students, warning them of the hazards involved and the need to follow written instruction, and to supervise the class during performance of the experiment. Distribution of written procedures does not in itself relieve teachers of their professional liability.

- In another case, a shop teacher was sued when a nail thrown by a student injured another student while the teacher was out of the room. The teacher was in an adjoining room helping other students put away projects. The suit cited four areas of neglect against the teacher:

  - Failing to properly supervise students.
  - Failing to remove the student when his behavior became dangerous to others.
  - Failing to discipline students to prevent them from throwing objects.
  - Failing to warn students of dangers of throwing objects in the classroom.

  As part of the safety rules for this woodworking class, the teacher had forbidden the throwing of objects in the class, warned them of the hazard involved, and disciplined students who violated the rules.

  The court ruled in favor of the teacher. Had the teacher been found at fault in any of the four areas, contributory negligence would have been sustained and the teacher could have been found liable. The court did not rule negligence on the part of the teacher for being absent from the room. The court's decision on this point was based on the inability of a teacher to personally and continuously supervise each student

under his or her care. A teacher must rely to some extent on the responsibility and maturity of students to conduct themselves in a safe and proper manner.

Had the teacher's absence from the class been nonjob related or had he been far removed from the class, the court's findings would probably have been different. For the teacher not to be ruled liable for student injuries that occur while the teacher is out of the classroom, contributory negligence would probably have to be proven.

To avoid becoming involved in litigation as the result of a student injury, you should:

- Take nothing for granted
- Make safety a part of the everyday science activities
- Give safety instructions prior to any experiment or field trip
- Establish and adhere to safety rules
- Review and use this and other appropriate safety literature

SELECTED SAFETY DIRECTIVES

The following are excerpts from relevant laws and regulations:

- *Texas School Law Bulletin,* Texas Education Agency Publication AD8 013 01, Section 21.909

Sec. 21.909. PROTECTIVE EYE DEVICES IN PUBLIC SCHOOLS.

(a) Industrial quality eye-protective devices shall be worn by every teacher and pupil in Texas participating in any of the following courses:

(1) vocational or industrial arts shops or laboratories involving experience with:

(A) hot molten metals;

(B) milling, sawing, turning, shaping, cutting, or stamping of any solid materials;

(C) heat treatment, tempering, or kiln firing of any metal or other materials;

(D) gas or electric arc welding; or

(E) caustic or explosive materials; or

(2) chemical or combined chemical-physical laboratories involving caustic or explosive chemicals or hot liquids or solids.

(b) In this section, "industrial quality eye-protective devices" means devices meeting the standards set by the State Department of Health.

(c) The governing boards and administrators of Texas school districts offering any of the listed courses are responsible for furnishing free of charge or providing at cost to teachers and pupils participating in the courses the required eye-protective devices.

(d) Whenever an accident occurs during the conduct of any of the courses described in Subsection (a) of this section, and an injury to the eye of a teacher or pupil results, the Principal shall make a full written report of the accident and injury to the State Department of Education.* The department shall prescribe the form and content of the reports and shall maintain a file of all reports submitted.

- *Standards for Eye Protection in Public Schools,* Texas Department of Health, Occupational Health Regulation No. 5

  - Sec. 5.5.1 Description. Goggles shall consist of a frame (composed of a flexible, chemical-resistant, nontoxic, non-irritating, and slow-burning material, forming a lens holder), lense, and a positive means of support on the face such as an adjustable headband of suitable material to retain the frame comfortably and snugly in place in front of the eyes. The lens holder shall be such that the lenses are held firmly and tightly and may be removed or replaced without the use of tools. The goggles may be ventilated or not, as required by their intended use. Where chemical goggles are ventilated, the openings shall be such as to render the goggles splashproof.

  - Sec. 5.5.2 Protection. Goggles shall provide eye protection from fine dusts, fumes, liquids, splashes, mists, and sprays.

  - Sec. 5.5.3 Application. Specific application for use of flexible fitting goggles will be found in Table 1.

  - Sec. 5.5.4 Materials and Methods of Test. Plastic lenses used in flexible fitting goggles shall be not less than 0.050 inch in thickness. Materials used shall be capable of withstanding the disinfection, corrosion resistance, water absorption, and flammability tests outlined in Section 6.

  - Sec. 6.2 Disinfection. All materials shall be such as to withstand, without visible deterioration or discoloration, washing in detergents and warm water, rinsing to remove all traces of detergent, and disinfection by the following methods:

    (1) Immersion for 10 minutes in a solution of formalin made by placing one part of 40 percent formaldehyde solution in nine parts of water at a room temperature of 68° F.

    (2) Subjection to a moist atmosphere of formaldehyde for a period of 10 minutes at a room temperature of 68° F.

    (3) Immersion for 10 minutes in a solution of modified phenolics, hyprochlorite, or quaternary ammonium compounds in strength specified by the manufacturer at a room temperature of 68° F.

*Division of Administrative Services, Texas Education Agency, 201 East 11th Street, Austin, Texas 78701.

SELECTION OF EYE- AND FACE-PROTECTIVE DEVICES

Hazard Involved	Part To Be Protected	Permissible Protective Devices Type
Dust and small flying particles	Eyes, Face	Goggles Spectacles Face Shields
Gases, fumes, and smoke	Eyes, Face	Goggles
Liquids	Eyes, Face	Goggles Face Shields

IF AN INCIDENT OCCURS

By law, eye-protective devices must be worn whenever an experiment or project is in progress where the potential for an eye injury is present. You as a prudent teacher would request even the casual visitor to wear eye-protective equipment when the potential for injury exists.

What do you as a science teacher do in the event of an incident?

The following guidelines should be adapted to your needs. Additions, deletions, or changes can be made to fulfill requirements of the school district, superintendent, principal, and insurance company. The word *incident* should be used when investigating, describing, or reporting an *accident*. The word *accident* implies that someone is at fault. The determination of who or what is at fault will be determined as a result of your investigation or perhaps by litigation.

Basically, three types of incidents can occur in or out of a science classroom:

- An incident without student injury
- An incident with minor or nondisabling injuries
- An incident with permanent or temporary disabling injuries

All incidents should be investigated to determine cause and to take necessary corrective measures. Written documentation should be maintained. Even though an in-depth investigation may not be required of every incident, the teacher must evaluate and decide what information is needed, then collect it. A thorough investigation is required in the event a serious or potentially serious injury should occur. Since the length of time to final settlement is long, the preserving of evidence collected as a result of your investigation is of primary importance. Physical evidence and the memories of witnesses either change, disappear, or become distorted over a relatively short period of time. In gathering information relating to the incident, do not distort or attempt to lead any witness of the incident into making biased statements. Your responsibility is confined to fact finding and not fault finding.

What types of evidence must you accumulate and retain?

- Incident reports and statements from students or other persons who saw the occurrence or have information that is supportive of the investigation.
- Notebooks, written instruction, and textbooks. (Make photocopies, if necessary.)
- Material or equipment relating to or involved in the incident. Where possible, do not disturb any equipment or materials involved until your investigation is complete. If possible, take numerous pictures. A sketch of the incident site and surrounding areas may be appropriate.

If circumstances preclude following the steps in an investigative procedure as outlined, just remember to collect information in a logical, unbiased manner.

Should a major incident occur, established procedures must be followed for retaining needed data. Record all information regarding the notification of concerned parties: superintendent, principal, and insurance company representative.

What protection do you have?

Due to the large monetary awards common in today's court decisions, you may wish to carry insurance coverage that affords protection. Membership in Texas State Teachers Association (affiliated with the National Education Association) or with Texas Federation of Teachers Association (affiliated with American Federation of Teachers) provides each member with $500,000 of professional liability coverage per occurrence. Coverage is limited to a single incident, regardless of the number of students injured or the severity of injury, and $500,000 is the maximum amount of insurance coverage. Nonmember teachers may wish to consult their local school district office for additional protection.

SCIENCE LABORATORY MANAGEMENT

To ensure the safe and effective operation of the science instructional program and to protect the investment represented by science laboratories and their physical contents, each district should appoint a person(s) to have the responsibility of the overall supervision of science laboratories. In a multicampus school district, the science supervisor(s) should coordinate the supervision of the laboratories on each campus through the respective science department chairperson. Each campus should have a person designated to be responsible for supervision of the science laboratories on that campus. The department chairperson will have numerous management and supervision responsibilities. Among these are to:

- arrange and store chemicals
- prepare, label, and date stock solutions
- dispose of outdated reagents
- arrange items according to compatability in storage areas, keeping in mind that:
    - some chemicals should not be stored with some other chemicals
    - some chemicals give off vapors that can explode in the presence of equipment that sparks
    - bottom shelves should be used for storage of heavy or large items
    - laboratories and storage areas should be well lighted and ventilated

Chemicals should be ordered in quantities that will be used within a reasonable time to ensure a fresh supply. Some chemicals such as peroxides, perchlorates, chlorates, picrates, and nitrates may form unstable decomposition products upon extended storage and create a safety hazard.

Since equipment in the biological laboratories is commonly used with both corrosive materials and biological specimens that could carry pathogenic organisms, attention should be given to the supervision of their cleaning and sterilization. Too, dull and/or corroded equipment can present a safety hazard.

The department chairperson should assist and be responsible for planning, ordering, and maintaining stock items in keeping a current inventory of science laboratories. In addition, he or she will be responsible for keeping the lecture-laboratory storage areas clean and orderly and otherwise conducive to learning.

RECOMMENDED SAFETY PROCEDURES

The following recommendations for providing for the safety of students performing laboratory investigations are grouped under the headings: General Laboratory Safety, Safety in the Elementary Science Classroom, Physical Science, Life Sciences, and Earth Science. However, should an activity in biology, for example, involve the use of chemicals, you may wish to review the Physical Science section for pertinent comments.

GENERAL LABORATORY SAFETY

Most accidents can be avoided by replacing unsafe habits with safe practices. The main causes of accidents are: (1) carelessness, (2) insufficient knowledge, (3) taking unnecessary risks, or (4) being in too great a hurry.

It is your responsibility to:

- Review each experiment or demonstration prior to allowing students to replicate the activity. Look for possible hazards and alert students to potential dangers. Safety instructions unique to a laboratory activity are to be given each time an experiment is begun.
- Never to assume an experiment is free of safety hazards just because it is found in a commercial publication
- Promote positive student attitudes toward safety. Students should not fear doing experiments, using reagents or equipment, but should respect them for potential hazards.
- Maintain constant surveillance and supervision of student activities. A partial glass partition between lecture area and laboratory is a convenient way to provide visual monitoring.
- Set good safety examples when conducting demonstrations and experiments
- Observe good housekeeping in maintaining safe laboratory conditions

In addition, you should see that the following rules and suggestions are adhered to when laboratory investigations are being performed:

- Contact lenses should not be worn in the laboratory.
- Long hair is to be confined and no loose clothing worn. Laboratory aprons should be worn.
- Proper eye protection devices are to be worn when engaged in, supervising, or observing science activities involving potential hazards to the eye.
- All hot plates and gas burners are to be turned off when not in use.
- Frequent safety inspections of the labortory are to be conducted. Any hazards are to be reported in writing to the building principal.
- Fire blanket(s) and fully-charged fire extinguisher(s) shall be located in each laboratory.

- Chemistry laboratories should contain an emergency shower, eyewash fountain, separate room exhaust system, and approved safety goggles for all students, teacher(s), and visitors.
- Each laboratory should have two unobstructed exits.
- For safety reasons, one teacher should not supervise more than 24 students engaged in laboratory activities at any one time.
- After each use, all work surfaces in the chemical and biological laboratory are to be thoroughly cleaned.
- Ventilation systems in chemistry laboratories should be functional. Fume hoods should be used in any activity involving flammable or toxic substances.
- Food and beverages are not to be allowed in the laboratory, and laboratory equipment should not be used to drink from.
- Care is to be taken in noting odors or fumes from a bottle. A waffing motion of the hand is to be used to bring a sample of the vapor to the nose.
- A suction bulb, not mouth suction, is to be used in filling pipettes with chemical reagents.
- Safety items such as safety tongs, heat insulated mittens, aprons, and rubber gloves are to be used.
- Master controls for all utilities should be conveniently located and available to the laboratories served.
- All master cutoff valves and switches for rooms under the science teacher's supervision should be located before laboratory work is begun.

Proper storage practices are essential to the safe operation of a laboratory. The following precautions should be taken into consideration:

- Laboratory chemicals and equipment should not be stored in the same room.
- Storage rooms containing flammable, toxic, or combustible substances should be properly ventilated.
- The chemical storage area should be secured at all times when not in use, with access only to authorized personnel.
- Combustible chemicals are to be locked in a fire-resistant cabinet.
- Flammable or toxic gases are to be stored at or above ground level.
- Gas cylinders should be secured against falling over and should be stored away from heat sources.
- All chemicals are to be labeled and separated according to class. (Reducing agents are not to be stored with oxidizing agents.)
- A fire extinguisher must be immediately accessible. (The multipurpose type is safe to use on Class A, B, and C fires.)
- Chemicals are to be mixed and transferred only in well-ventilated and properly equipped areas.

- Storage areas should have unobstructed access aisles.
- Open flames, smoking, or any other type of heat is not to be permitted in the chemical storage area(s).
- Cleanliness and order in the storage area is to be maintained at all times.
- Chemical storage areas should be well ventilated and lighted.
- Acids and other solvents are to be stored on or near the floor level.

Electrical equipment is frequently used in laboratory investigations, including physical, biological, and earth science courses and in activities with elementary students. The following are general guidelines that are to be followed whenever electrical equipment is used. (See Physical Science, page 12, for additional recommendations.)

- Students should be taught safety precautions regarding the use of electricity in everyday situations.
- Students should be cautioned to exercise care when using electrical current.
- Batteries or cells of 1.5 volts or less are safe for classroom use. However, the battery may explode if heated or thrown into an open fire. The chemicals inside the battery can be dangerous if taken internally.
- The use of a 110-volt (or greater) line should be approached with caution.
- Electrical equipment should be properly grounded
- A portable ground-fault circuit breaker should be used for all laboratory AC circuits during laboratory investigations.
- A master switch to cut off electricity to all stations should be available for all laboratory AC circuits.
- Properly-grounded service outlets and only three-wire extension cords are to be used.
- Electrical wires with worn or frayed insulation are not to be used.
- Metal water and gas pipes are grounded. A ground and an electrical circuit are never to be touched simultaneously.
- Work areas, including floors and counters, should be dry.
- Electrical equipment is never to be handled with wet hands or while standing in a damp area.

SAFETY IN THE ELEMENTARY SCIENCE CLASSROOM

A safe environment for the student to make science discoveries can be provided by the use of common sense along with a few appropriate rules. Most of the following rules and safety practices apply to the elementary classroom as well as to the secondary science classroom. However, some special considerations must be taken into consideration when working with elementary students. Elementry students are very curious; however, they are not yet wise in the ways of avoiding personal injury. The attitudes of students about their world may become quite positive as a result of safe learning experiences in science.

Instruct students to report any accident to you immediately. For minor injuries, immediately notify the principal and/or school nurse and see to it that first aid is administered by a trained person. For more serious injuries, notify the parent or guardian as soon as possible. Keep an emergency number on file for an alternate or family doctor. Call emergency help if necessary.

General rules to remember are:

- Be knowledgeable of your school's policy and procedures concerning injuries
- Be knowledgeable of your school's policy and procedures about classroom management
- Be knowledgeable of your school's fire regulations
- Perform regularly a safety check of your classroom
- Never allow students to touch, taste, or smell any substance without first obtaining specific instructions from you, the teacher
- Instruct students that it is unsafe to touch their face, mouth, or eyes while they are working with plants
- Do not allow students to mix any chemicals without proper instructions
- Instruct students in the proper handling of glassware. Substitute plastic containers when possible to minimize hazards.
- Do not allow students to perform any electrical experiment without proper instructions and supervision

Guidelines for having animals in the classroom are:

- Discourage students from bringing personal pets into the classroom. Personal pets should be handled only by their owners.
- Do not allow students to tease an animal or thrust their fingers into its cage
- Instruct the students to handle the animals with care and use gloves where possible
- Be sure that no diseased animals are brought into the classroom
- Check with the school and local authorities concerning regulations on handling small animals

Guidelines for having plants in the classroom are:

- Do not allow students to handle any unidentified or unfamiliar plant
- Be sure students wash their hands immediately after handling plants before they touch their eyes, mouth, or face
- Be familiar with poisonous plants found in your area
- Do not place any plant or part of a plant in the mouth

PHYSICAL SCIENCE

The following are guidelines you must insist students follow when performing physical science (physics, chemistry, or physical science) laboratory investigations:

- Use proper protective devices (goggles, aprons) when hammering, chipping, or grinding rocks, minerals, or metals.
- Never view the sun directly.
- Never look directly into ultraviolet light sources without proper eye protection.
- Never point the open end of a heated test tube toward anyone. Rapid heating of substances may cause contents to be violently ejected.
- Use volatile liquids such as ether, gasoline, alcohol, carbon disulfide, and benzene in very small quantities in a well-ventilated room. Heat such substances electrically or in water baths; never bring them near a flame.
- Use glassware that is neither cracked nor chipped.
- Never directly breathe any prepared gases; all are dangerous in high concentrations. Breathing only carbon dioxide will result in unconsciousness within a matter of seconds.
- Never taste any laboratory chemical. Eating and drinking in the laboratory should be prohibited.
- When heating materials in glassware by means of a gas flame, place the glassware on a wire gauze.
- Pour acid into water while stirring, never water into acid.
- Promptly remove broken glass from sinks.
- Operate the fume hood and/or room exhaust fan when dealing with highly volatile, toxic fumes.
- When working with flammable liquids, remember:
    - Have a CO_2 or multipurpose fire extinguisher available
    - Work in a well-ventilated area
    - Keep the liquid over a pan or sink
    - Use no flames or high-temperature heating devices
    - Do not store flammables in a home-type refrigerator. Fumes may be ignited by sparks produced in the electrical switching system. (Explosion-proof refrigerators are available from science supply houses or appliance stores.)
- Never heat a battery or throw one into an open fire.
- Use high voltage AC (such as 110-volt wall socket) only under proper supervision. Be sure the circuit is properly grounded.

- Never direct a student to conduct unsupervised experiments with household current.
- Be sure all work areas are dry before beginning an experiment in which electrical equipment is used. Never handle electrical equipment with wet hands.
- Avoid using multipurpose plugs in electrical outlets; circuits can quickly become overloaded.
- Do not use electrical wires with worn insulation.
- Use properly-grounded service outlets.
- Locate the master switch for cutting off electricity to all stations before beginning electrical experiments.
- Never permit students to apply a voltage to a device which uses an electron beam except under supervision, as all are capable of producing X rays.
- Become thoroughly familiar with the potential hazards of and proper safety precautions for using X-ray equipment or devices capable of producing X ray before using them.
- Never operate a laser without becoming familiar with laser safety. Even low power helium-neon lasers are potentially hazardous, producing effects that may not be immediately evident.
- Handle mercury with care. It is poisonous and the effects are cumulative.
- Collect spilled mercury by pushing the pools (droplets) together using index cards. Next use an aspirator to gather up the mercury. An aspirator is made by attaching a suction bulb to the blowing tube of a wash bottle, a fine pipette, or capillary tube to the spout tube. Then sprinkle the area with sulphur, leave for a short period of time, then sweep up.
- Never decompose mercuric oxide, either as an experiment or as a teacher demonstration.
- Never permit students to operate model rockets without first providing safety instructions. Carefully supervise all activities involving the use of model rockets.
- Exercise caution when using alcohol lamps. An alcohol flame is hard to see and can easily ignite hair or loose-fitting clothes.
- Never permit students to move a lighted alcohol lamp across the room. Should it be dropped, the flame can cover a large area instantaneously.

LIFE SCIENCES

Live animals and plants are essential to the study of the life sciences. Their indiscriminate care and use in the classroom, however, may introduce students to unnecessary safety risks. Additional risks are present, outside the classroom, that must be taken into consideration prior to conducting outdoor investigations and field trips.

Animals In The Classroom

The use of live animals in the classroom is essential if students are to fully understand and appreciate life processes. Students, regardless of age, need ample opportunities to observe and experiment with living organisms. Be sure to establish and review with students safety guidelines prior to handling living organisms. This protects students and helps ensure the humane treatment of animals.

The following guidelines should be followed in labortory investigations:

- When living organisms are needed, use species such as plants, bacteria, fungi, protozoa, worms, snails, or insects. They are readily available, simple to maintain, and easy to dispose of, making them especially suitable for student work.
- Never use a procedure on a warm-blooded animal that might cause it pain or any type of discomfort.*
- Never perform surgery on a living vertebrate animal.*
- Do not perform experiments with vertebrates that inflict harm, disease, or discomfort.*
- Student experiments involving the observation of animals must be closely supervised by the teacher.
- Animals used for study must be properly fed, given sufficient water to drink, provided with ample living space, and handled humanely at all times.
- Embryos used for investigation must be killed no later than the 19th day of incubation. If embryos are to be hatched, proper arrangements must be made for the care or humane disposal of the younglings (such as chicks).
- All mammals used in the classroom must have been inoculated for rabies.

Observe the following general safety recommendations regarding the use of animals in the classroom:

- Do not permit students to bring pets to the classroom unless the activity has been carefully planned.
- Have students wash their hands after handling animals.
- Caution students never to tease animals.
- Return native animals to their environment after the observation period.

*The only exception is a procedure performed under the supervision of a person from a bonded institution.

The following recommendations apply to specific types of animals normally maintained in the classroom.

MAMMALS

Care:

- Cages shall be cleaned and disinfected a minimum of once per week.
- Cages shall be draft-free with secure lids and/or doors to prevent escape or unauthorized handling.

Handling:

- Remove a mouse or a gerbil from the cage by grasping the base of the tail; support the body with the other hand.
- Remove a guinea pig by grasping the forequarters with one hand and placing the other hand underneath the hind-quarters.
- A hamster should be removed by grasping the nape of the neck (scruff of the neck) between the thumb and forefinger.
- Do not grab a small mammal around the major portion of the body as this usually results in a bite.
- Do not free small mammals to explore table tops or other areas where falls or injury may occur.
- Handle all small mammals gently and quietly and never squeeze them.

REPTILES

Care:

- Keep native reptiles in cages with secure tops and/or doors to prevent their escape. Be sure there are no openings or loose fitting tops through which reptiles could escape.
- Make cages of solid wall construction with one side modified for ventilation.
- Maintain a temperature in a 78-85°F. range.
- Construct cages of appropriate size to allow exercise.
- Be sure that the wire mesh used for ventilation is of sufficient size to prevent escape.
- Clean and disinfect cages once each week.
- Provide a water bath.
- Know the nutritional requirements of each reptile and provide the appropriate amounts of food at weekly intervals.

- Some reptiles require small mammals for feeding. Be sure to remove uneaten ones after it is determined that the reptile is not going to feed.

- Never disturb a feeding reptile, especially a snake. When disturbed, the reptile may regurgitate the food and possibly strangle.

- Never allow fecal material from reptiles to be placed in sinks, drinking vessels, or any lab equipment used by humans. Infection may result.

Handling:

- When tame snakes are handled, take care not to squeeze them.

- To remove a snake from its cage, place one hand under the first third of the body, the other hand slightly past the animal's center, and remove it gently.

- Never allow untrained persons to handle snakes known to bite.

- Move with caution in the presence of a snake. Rapid, sudden movements may induce a strike from even a tame snake.

- A snake is about to shed when its eyes are cloudy. To avoid a possible bite, never handle a shedding snake until the process is complete.

- Unless immediate supervision is present, never keep poisonous reptiles in the classroom.

- Never examine freshly-killed, poisonous reptiles without immediate supervision. A reflex bite may be sustained.

- Handle lizards by grasping the full body in one hand, firmly, but gently. Never attempt to pick up a lizard by the tail.

- Most tortoises may be held by placing both hands on the edge of the top shell and curling the fingers around the edges to the lower shell. CAUTION: Loggerheads and softshell turtles can inflict serious injury and should be handled only by persons knowledgeable in such procedures. Wash thoroughly after handling turtles; they are carriers of salmonella.

- Return native reptiles to their natural environment after observing them.

A state permit, available from the Permit Division, Texas Parks and Wildlife Department, is required to have a protected animal in your possession. A permit is also required if unusual trapping techniques are to be employed in the capture of native wildlife.

INSECTS AND SPIDERS

Care:

- Keep spiders and insects in a clear glass or plastic container with a secure screen-wire lid.

- Duplicate the animals' natural environment as closely as possible.

- Provide adequate amounts of the proper food.
- Most spiders and insects have a short life span, making a three- to four-day observation period adequate. Release them in the same general area as captured.
- Never keep poisonous insects or spiders in the classroom without the immediate supervision of a trained person.

Handling:

- Many of these organisms are fragile and should not be handled when alive. Large specimens may be handled with care.
- Kill insects and spiders in jars with alcohol vapor or carbon dioxide. Cyanide compounds are quite dangerous and should be avoided.

PROTOZOANS

Bacteria:

- Even though bacteria normally used in public schools are non-pathogenic, handle all cultures as if they are.
- Tape shut all culture plates following inoculation.
- Destroy cultures either chemically or with heat following a laboratory exercise.
- Instruct all students in bacteriological techniques and insist they be followed while conducting experiments.

Fungi:

- Use the same procedure with fungi as with bacteria.
- Never allow persons to taste or ingest any of the fungi such as locally-collected mushrooms, Penicillium, or Rhizopus.

Liquid Cultures: Never taste or ingest a liquid protozoan culture.

NOTE: E. coli can irritate the mucous membranes of the eyes, nose, and ears.

PRESERVED SPECIMENS

- When dissecting specimens preserved in formalin, the vapor may cause eye or epidermal irritation. To avoid this, bathe the specimens in fresh water for 24 hours prior to their use.
- Use scissors for dissecting specimens, not razors or double-edged scalpels.

CHEMICAL HAZARDS

- Handle hot liquids with care.
- Don't taste papers such as pH or litmus or any test solution (Fehling's or Benedict's). Store or prepare papers intended for tasing (such as PTC) under sterile conditions.
- Label and date the contents of containers.
- Properly dispose of used containers.

EQUIPMENT

Properly treat equipment used repeatedly by students to reduce and/or remove any possible contaminent or disease agent. Among the types of equipment that require sterilization or proper treatment are stethescopes, blood pressure equipment, blood testing equipment,* thermometers, respiratory apparatus, and pipettes.

Plants In The Classroom

The use of plant life in the classroom is both educationally sound and aesthetically pleasing. Normally, there are few precautions to be heeded in relation to plants. However, you must be mindful of their potential dangers as well as their beauty. Each locale across the state has plants that are native, cultivated, or introduced that present hazards of either a mechanical or chemical nature.

Thorns are the most obvious mechanical problem encountered in plants used in the field or classroom situation. Students in both situations should not be allowed to use such plant materials for projectiles or other types of "horseplay." Some species of grasses, such as spear grass and grass burrs, possess modified seeds which render them a nuisance and a possible cause of irritation. Most problems associated with plants are of a chemical nature encountered when parts of the plants are ingested or crushed on the skin. Students, especially the younger ones, should be instructed never to ingest any part of a plant in laboratory exercise or field studies without a thorough knowledge of the plant. Perhaps the best example of potential problems are the tomato and potato; both are edible, but the foliage of both plants if eaten may be fatal. Domesticated plants also have associated problems, and with the increased popularity of house plants, another dimension of concern has arisen.

Extra care must be taken with plants such as dracaenas dumb cane (Diffenbachia sp.) and yews to prevent accidental poisoning. Much remains to be learned about the results of ingestion of many plant parts. With the increasing number of mutant strains appearing on the market, the rate of caution in their handling increases.

GENERAL PLANT-USE GUIDELINES

- Be familiar with the dangerous plants in the area of study.
- Do not put any part of an unfamiliar or poisonous plant in the mouth.

*Parental or guardianship permission slips should be required for use.

- Do not rub unfamiliar or poisonous plant sap or juice into the skin or an open wound.
- Do not inhale or expose skin or eyes to the smoke of any burning plant.
- Do not pick unknown cultivated or wild flowers.
- Do not eat food or drink fluids after handling plants without thoroughly washing and rinsing the hands.
- Do not depend on folklore methods for distinguishing nonpoisonous from poisonous plants.
- Be aware of possible hypersensitivity of persons to handling plants.

REPRESENTATIVE LIST OF PLANTS, THEIR TOXIC PARTS, AND SYMPTOMS

NOTE: This list presents some well-known plants for the purpose of illustrating the precautions that should be exercised when working with plants in the laboratory or field. It is not inclusive of all hazardous plants found in the state.

Plant	Toxic Part(s)	Symptoms
Hyacinth, Narcissus, Daffodil	Bulbs	Causes nausea, vomiting, diarrhea. May be fatal.
Oleander	Leaves, branches	Is extremely poisonous, affects the heart, produces severe digestive upset, and has caused death.
Dieffenbachia (Dumb Cane) Elephant's Ear	All parts	Causes intense burning and irritation of the mouth and tongue. Death can occur if base of the tongue swells to block air passage of the throat.
Castor Bean	Seeds	Can be fatal. Single bean seed may kill child; two are near lethal dose for adults.
Mistletoe	Berries	Can be fatal.
Lily of the Valley	Leaves, flowers	Causes irregular pulse, is usually accompanied by digestive upset and mental confusion.
Iris	Underground stems	Causes severe, but not usually serious, digestive upset.
Rhubarb	Leaf blade	Can be fatal. Large amounts of raw or cooked leaves can cause convulsions, coma, followed rapidly by death.

Yew	Berries, foliage	Can be fatal. Foliage more toxic than berries. Death usually sudden without symptoms.
Wild and cultivated cherries	Twigs, foliage	Can be fatal. Contains a compound that releases cyanide when eaten. Gasping, excitement, and prostration are common symptoms that often appear in minutes.
Buttercup	All parts	Irritant juices may severely injure the digestive system.
Nightshade	All parts, especially the unripe berry	Can be fatal. Intense digestive disturbances and nervous symptoms.
Poison hemlock	All parts	Can be fatal. Resembles a large wild carrot. Used in ancient Greece to kill condemned prisoners.

NOTE: In the event a student displays plant-caused systematic reaction, contact the local poison control center for advice and recommended procedures to follow until parents are contacted.

Field Trips

Field trips are an essential part of the science curriculum. One of the most effective ways to study some of the natural phenomena is to observe them in their own settings. A field trip can be a valuable teaching/learning experience for both teacher and student. A poorly planned field trip can be a waste of time and worse than no trip at all. In addition to having well-stated educational objectives, pretrip preparation, and effective follow-up activities and discussion, every precaution should be taken to assure the safety of students and teaching personnel while on a field trip. Observe the following general safety guidelines to make field trips safe and effective as teaching strategies:

- Visit the site prior to the actual field trip. As the teacher, you should have a thorough knowledge of the field trip area, including obvious dangers such as poisonous plants and snakes, possible waterfall areas, and electrical hazards.
- Establish rules for safe conduct prior to the trip, and make sure they are observed by all present.
- Inform students of the potential dangers of the area, especially when field trips are to be conducted near deep or rapidly-moving water. Never permit poor or nonswimmers in any body of water.
- Dress according to the demands of the terrain and weather.
- Have adequate supervision, teachers and parents, for the class size.
- Use the buddy system (a student shares responsibility for his or her partner).
- Take a well-stocked first-aid kit; include a snake bite kit.

- Be sure that proper consent forms are completed and signed, according to school policy, and turned in to you prior to departure.
- Avoid taking glass containers on the field trip.
- Include appropriate repellants to protect against mites, ticks, and mosquitoes.
- Weigh the economy of private cars for transportation against the educational benefit and safety of having all students on the same school or private bus.
- If the field trip is to include potentially harzardous activities, discuss and demonstrate proper safety procedures prior to the trip.
- Students will remain under adult supervision at all times.
- If private land is used for the field trip, obtain the land-owner's permission, preferably in writing with a disclaimer of responsibility, prior to work on that land.
- In case of a reptile bite:
    - Determine whether or not the reptile is poisonous
    - If nonpoisonous, follow guidelines in the first-aid section dealing with treatment of
    - If poisonous, follow the directions in the first-aid manual and seek medical attentio
- In case of a poisonous insect bite:
    - Determine the type of insect that inflicted the wound
    - For most bites and stings, a cold compress applied to the area will bring relief in a short period of time
    - Should persons be hyper-sensitive to bites or stings, this must be known prior to the trip. They should have medication with them. If needed, the medication should be administered according to the doctor's directions. Closely observe the biten or stung individual. Should medication not be available, get medical attention to the person as quickly as possible. Immediately notify the student's parents.
- Notify as soon as possible the administrators and parents of any student involved in an incident.

EARTH SCIENCE

In addition to safety precautions listed elsewhere in this publication, the following are additional steps that you, the earth science teacher, must take to ensure the safety of students.

- To avoid ingestion or inhalation of particles thought to be toxic, wear a breathing mask or filter when grinding the following materials:
  - Abalone shell (dry)
  - Any minerals containing lead, mercury, cadmium, arsenic, copper, nickel
- Always grind, shape, or polish Abalone shell with a water spray on the wheel (irritating fumes are released when worked dry).
- Wear a mask when chrome oxide polish is being used.
- Never push hard when using a grinder. Excessive heat may build up in either the stone or machine, causing the stone to fracture, the machine to overheat, and the stone to grab and be torn from the grasp of the operator.
- Always keep the cutting surfaces of a rock cutting machine well lubricated, either with water or with light coolant oil. Running a machine dry may cause damage to the machine and/or rock.
- Use a sump or bucket to catch cuttings carried away by water or sediment from stream tables. Sink drains are quick to clog.
- Wear goggles whenever breaking, grinding, or crushing rock samples.
- Use appropriate safety techniques when looking through a telescope.
- Follow proper procedures when planning and conducting a field trip (see Field Trips, page 20).

SPECIAL INSTRUCTIONS

Potential hazards exist when students engage in the activities commonly performed in any science class, regardless of subject. Students and teachers may need to handle glassware, dispose of chemicals, use radioactive materials, and operate a laser or other electronic equipment. Several commonly available pieces of equipment may produce X rays. Students in physics classes or in science clubs frequently work with model rockets, and specific precautions must be taken. For each of these areas, the following specific guidelines are presented that, if followed, will greatly reduce the potential risk of student injury.

HANDLING GLASSWARE

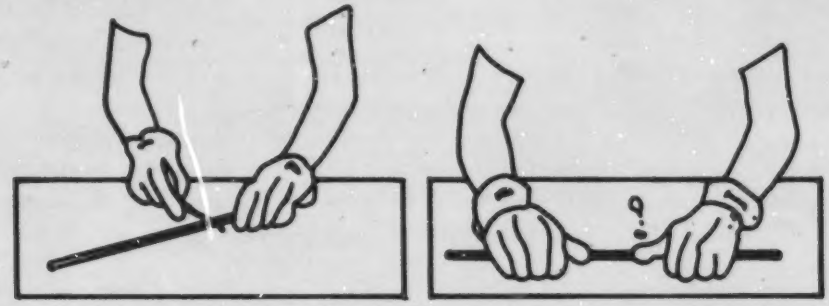
Glass is especially suitable for laboratory work, but its use can be hazardous. A high percentage of all laboratory accidents are due to improper handling of glassware. The precautions listed below should be followed whenever laboratory work involves the handling of glassware.

- Glassware that is to be heated should be of the borosilicate type such as Pyrex and Kimax. Never use soda-lime glass unless instructed to do so.
- Dispose of broken glassware in such a way as to minimize the danger of cuts. Use a dustpan and broom to pick up the large pieces of glass and wet cotton to pick up small ones. Do not pick up broken glassware with fingers.
- Glass is a poor conductor of heat. Therefore, you can even burn yourself on glassware that has been cooling for several minutes.
- Do not use glass when mixing potentially explosive compounds.
- Do not use glass reagent bottles for highly flammable materials. Less flammable materials in glass containers should be stored in metal receptacles large enough to contain the material in the event of breakage.
- Carry and/or store packages of glass tubing vertically.
- Handle "frozen" glass-to-glass surfaces with extreme care. Loosen the joints under a stream of hot water, but be sure to wear gloves or protect the hands with a towel.

Glass tubing is usually purchased in long sections. The following steps are to be taken in cutting the required lengths:

- Lay the tubing in a notch or groove on a flat surface or lay it on a flat surface, holding it firmly near the point where the cut is to be made.
- Draw the edge of a triangular file across the tubing to produce a deep scratch (see diagram).
- Wear gloves or wrap the glass in a cloth before attempting to break it.
- Grasp the tube with both hands with the thumbs together on the side opposite the scratch (see diagram, page 24).

- Snap the tube by pushing outward with the thumbs and simultaneously pulling back with the fingers.



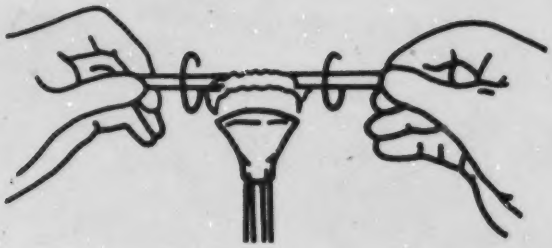
To Cut Glass Tubing

- Fire polish the ends of glass tubing to be used in the laboratories by:
  - Holding the glass tubing so the end is in the hottest part of the flame
  - Rotating the tube so all sides are heated evenly, causing sharp edges to visibly melt and become smooth
  - Placing the fire-polished tube on heat resistant material until it cools. Glass is a poor conductor of heat and takes several minutes to cool.

To Fire Polish Glass Tubing

The following procedures are recommended for bending and drawing glass tubing into needed configurations:

- Place a wing-top flame spreader on the burner.
- Hold the tube with both hands and heat the area to be bent (see diagram).
- Rotate the tubing to ensure even heating of all sides.
- Once the part of the flame around and above the blue portion becomes a distinct yellow, the glass is soft enough to bend or draw.
  - To bend: Quickly place the glass on a heat resistant pad and immediately bend to the desired angle.
  - To draw: When the glass becomes soft, pull both ends of the glass tubing. This pull should be done smoothly, with even tension. When the desired size and length are attained, lay the tube on a heat resistant pad to cool. Cut and fire polish it.



To Bend or Draw Glass Tubing

To prevent injuries when inserting glass tubing or rods in cork or rubber stoppers:

- Fire polish all glass tubing
- Use a lubricant when inserting glass tubing or thermometers into rubber stoppers
- To put glass into the stopper:
    - First run a cork borer through the stopper. Then slip the glass tubing into the cork borer, withdraw the borer, leaving the tube in the stopper; or
    - Wrap the tubing in several layers of cloth. Holding the tubing as near to the stopper as possible, push (do not force) the tube into the stopper. Always aim the tubing away from the palm of the hand holding the stopper.

To remove glass tubing, rods, or thermometers from old stoppers, cut away the stopper rather than risk injury from broken glass.

When clamping glassware:

- Wrap the glass in cloth or paper before clamping. Rubber may be used if the apparatus is not to be heated.
- Use care in tightening the clamp. Excessive tightening will bend the clamp or break the glass.

Cuts and burns may result from improper use of glassware. To minimize injuries:

- Use care in selecting glassware to be heated. Only Pyrex or similar heat-treated types should be used.
- When heating a flask or beaker over an open flame, place the glassware on a plain wire gauze to disperse the heat.
- Any localized overheating may crack glassware. Always heat glassware as slowly and evenly as possible.
- Do not use soft glassware with a reaction that produces heat.

STORING CHEMICALS

Many chemicals react violently, produce toxic fumes, and are fire hazards when they interact. The chemicals listed in the left-hand column should be stored in a manner that will prevent them from coming in contact with those in the right-hand column.

Do Not Store:	Close To:
Acetic acid	Chromic acid, nitric acid, perchloric acid, ethlylene glycol, hydroxyl compounds, peroxides, and permanganates
Acetone	Concentrated sulfuric and nitric acid mixtures
Acetylene	Bromine, chlorine, fluorine, copper tubing, as well as silver, mercury, and their compounds
Alkali metals (K, Na, Ca), powdered aluminum, and magnesium	Water (K & Na), carbon dioxide, carbon tetrachloride, and the halogens
Ammonia, anhydrous	Mercury, hydrogen fluoride, and calcium hypochlorite
Ammonium nitrate (a deliquescent, hygroscopic, powerful oxidizing agent)	Strong acids, metal powders, chlorates, nitrates, sulfur, flammable liquids, and finely divided organic materials
Aniline	Nitric acid and hydrogen peroxide
Bromine	Ammonia, acetylene, butane, hydrogen, sodium carbide, turpentine, and finely divided metals
Carbon, activated	Calcium hypochlorite, all oxidizing agents
Chlorates	Ammonium salts, strong acids, powdered metals, sulfur, and finely divided organic materials
Chromic acid	Glacial acetic acid, camphor, glycerin, naphthalene, turpentine, lower molecular weight alcohols, and many flammable liquids
Chlorine	Same as for bromine
Copper	Acetylene and hydrogen peroxide
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, sodium peroxide, nitric acid, and the halogens

Hydrocarbons (butane, propane, benezene, gasoline, and turpentine)	"Fluorine, chlorine, chromic acid, peroxides, and other strong oxidizing agents"
Hydrogen peroxide	Copper, chromium, iron (most metals or their salts), flammable liquids, and other combustible materials
Hydrogen sulfide	Nitric acid and certain oxidizing gases
Iodine	Acetylene and ammonia
Nitric acid	Glacial acetic acid, chromic and hydrocyanic acids, hydrogen sulfide, flammable liquids, and flammable gases that are easily nitrated
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, and gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohols, paper, wood, and other organic materials
Phosphorus pentoxide	Water
Potassium permanganate	Glycerine, ethylene glycol, and sulfuric acid
Silver	Acetylene, ammonia compounds, oxalic acid, and tartaric acid
Sodium peroxide	Glacial acetic acid, acetic anhydride, methanol, carbon disulfide, glycerine, benzaldehyde, and water
Sulfuric acid	Chlorates, perchlorates, permanganates, and water

NOTE: The *Manual of Hazardous Chemical Reactions* is recommended for high school science departments. The 470-page book (491M) is available from the National Fire Protection Associaion, 470 Atlantic Avenue, Boston, MA 02210.

CHEMICAL DISPOSAL

The problem of safe disposal of chemicals is important not only for the chemist but for those who might later come in contact with the material. The nature and quantity of a chemical must be considered in light of new national pollution laws to protect our environment. Chemical wastes should not be permitted to accumulate. Items should be properly disposed of immediately after they are no longer needed.

Disposal procedures are numerous and some are complex. The steps for disposing of chemicals usually encountered in science teaching present few major obstacles.

Neutralize common bases with diluted sulfuric acid. Then wash the neutral solution down the drain with an excess of water.

Neutralize common acids with sodium carbonate, and then wash them down the drain. Dispose of salt solutions in the same manner. All materials disposed of by washing down the drain should be soluble in water. Never flush materials down the drain that are either volatile, toxic, or insoluble.

Burn hydrocarbons, preferably in a solvent burner. Halogenated hydrocarbons should be burned in the presence of calcium hydroxide or sodium carbonate.

The following is a list of elements and compounds that according to the Manufacturing Chemists Association can be dumped into landfills or released into the air:

Argon
Asphalt
Batteries (dry cell)
Boron
Calcium carbonate
Calcium oxide
Carbon black
Chromium
Crude lime
Epoxy resin systems
Ferrosilicon
Helium
Hydrogen
Lamp bulbs
Latex
Magnesium oxide
Metal scrap
Molybdenum, insoluble compound
Neon
Nitrogen
Nitrogen fertilizers
Nitrogen trioxide
Oxygen
Ozone
Paint
Resin
Rubber
Scrap glass
Scrap stoneware
Silica
Sludges
Stones, alberine
Sulfur
Sulfur hexafluoride
Tar
Tin, organic compounds
Titanium oxide
Tremolite
Urea
Zinc oxide

Report to the departmental chairperson overaged or sulfur chemicals that, because of toxicity, pollution potential, or explosive danger, cannot be disposed of by dissolving, diluting, or flushing down the drain. Similarly, report carcinogenic compounds to the departmental chairperson, then contact the appropriate disposal agency for action.

Unstable elements, compounds, or mixtures may decompose explosively. A few such substances are routinely stocked in high school laboratories and require special precautions and handling. Among these are:

Ether
Formic acid
Ammonium nitrate
Sodium
Potassium
Lithium
Phosphorus
Ammoniacal silver nitrate solutions
Benzoyl peroxide
Nitrogen triiodide
Picric acid
Perchloric acid

A list of alleged cancer-causing compounds found in one state survey of science laboratories follows:

4-Nitrobiphenyl	Ethyleneimine
alpha-Napthylamine	beta-Propiolactone
beta-Napthylamine	alpha-Acetylaminofluorene
Methyl chloromethyl ether	4-Dimethylaminoazobenzene
3,3'-Dichlorobenzidine	N-Nitrosodimethylamine
Benzidine (4-4' Diaminobiphenyl)	Vinyl chloride
4-Aminobiphenyl	Acetone

Specific information on how to handle carcinogens may be obtained from:

Director, Bureau of Laboratories
Texas Department of Health
1100 West 49th Street
Austin, TX 78756

The following firms authorized by the Texas Department of Water Resources will provide assistance in disposing of hazardous chemicals and commercial industrial solid wastes:

Company and Mailing Address, Area Code/Telephone Number	**Material**
Browning-Ferris Chemical Services Division 300 Fannin Building, Houston, TX 713/741-1540	Oil Chemicals
Browning-Ferris/Renner, Inc. Box 1195, Nederland, TX 77627 713/722-0401	Oil Misc. waste materials
Browning-Ferris (McCarty Rd.) Box 3151, Houston, TX 77030 713/790-1611	Liquid wastes
Conservation Services Box 2563, Port Arthur, TX 77640 713/763-2821	Chemicals
Dal-Worth Industries 6110 Chippewa, Dallas, TX 75212 214/638-7840	Chemicals
Eltex Chemical & Supply Co. Box 4214, Houston, TX 77210 713/526-0918	Chemicals

Force Oil & Vacuum Truck Co. Box 9341, Houston, TX 77012 713/921-7115	Oil emulsions
Gulf Metals Industries Box 611, Houston, TX 77001 713/928-3111	Misc.
Gulf Coast Waste Dis. Auth. Bay-Port Treatment Plant 10800 Bay Area Boulevard Pasadena, TX 77507 713/474-4111	Certain sludges & wastewaters
Gulf Coast Waste Dis. Auth. Washburn Tunnel Plant 910 Bay Area Blvd., Houston, TX 77058 713/472-5507	Certain sludges & wastewaters
Intl. Pollution Control Box 9601, Corpus Christi, TX 78408 512/854-2358	Oil emulsions
Liberty Waste Disposal Box 3370, Baytown, TX 77520 713/424-1213	Misc.
Malone Service Co. Box 709, Texas City, TX 77590 713/945-3301	Oil Chemicals
Rollins Environmental Svcs. Box 609, Deer Park, TX 77536 713/479-6001	Petroleum Chemicals
Sheridan Disposal Service Box 42, Hempstead, TX 77445 713/826-3766	Oil
Sonics International One Energy Square, Dallas, TX 1-800/242-3209	Oils Chemicals
Texas Ecologists, Inc. Box 307, Robstown, TX 78380 1-800/242-3209	Oil Chemicals
Chaparral Disposal Co. P.O. Box 4653, Odessa, TX 79760 915/333-2826	Chemicals

RADIOISOTOPES

The federal government (under the U.S. Energy Research and Development Administration) has granted permission for teachers to use radioactive materials of low hazard potential. The State of Texas further regulates the use of radioactive materials for instructional use. Among the materials available for use are Carbon-14, Phosphorous-32, and Iodine-131. Use of materials other than those whose activity is in the microcurie range requires a special license (refer to *Texas Regulations for Control of Radiation,* Texas Department of Health). Observe the following safety precautions whenever radioactive materials are used:

- Keep accurate records of the kinds and quantities of radioactive materials possessed and which students either used or were present when the materials were used.
- Label all radioisotopes "Radioactive" and store them in locked cabinets conspicuously marked "Radioactive Material."
- Do not permit food, drink, or use of cosmetics in the general vicinity of the lab.
- Keep radioisotopes away from the eyes, mouth, and open sores.
- Pipette radioactive solutions only by bulb; do not use mouth suction.
- Use a fume hood when performing experiments in which there is a danger of inhaling fumes.
- Use tongs and rubber gloves when handling radioisotopes and scrub hands immediately thereafter.
- Use a detection device (such as a Geiger counter) to monitor the activity of all specimens brought to the laboratory and to check the hands after handling radioisotopes.
- Properly dispose of all contaminated materials after using. Should there be any question concerning the proper methods of disposal, contact the Texas Department of Health.

NONIONIZING RADIATION

Potential hazards are present whenever sources of ultraviolet, infrared, or microwave radiation are used. Teachers using such sources must provide adequate shielding for students' eyes and limit the length of time that the sources are used. The harmful effects incurred as a result of improper shielding are not immediately noticed. For best results, appropriate filters should be attached to the source rather than having students wear protective goggles. Mercury light sources (capable of emitting ultraviolet radiation), such as those purchased from scientific supply houses, are usually fitted with the proper shielding by the manufacturer; be sure the shielding is in place before allowing the sources to be used.

LASER SAFETY

The use of lasers in the science classroom has become increasingly popular. With the introduction of the low-powered Helium-Neon (He-Ne) gas lasers (1 milliwatt range), they are now commercially available at a nominal cost. He-Ne gas lasers can be used to demonstrate a wide range of optical phenomena. Ninety-two percent of the lasers used in high schools are of the He-Ne type. Their low output (found to range from 0.19 to 3.0 milliwatts) does not mean that these devices should be considered safe for students to handle. To the con-

trary, even the low output He-Ne beams are capable of burning the retinal area of the eye, producing a blind spot. Sufficient energy is deposited in .01 seconds under direct viewing of a laser beam to cause retinal damage. Under no circumstances should you use a He-Ne laser in the presence of students without first informing them of the possible dangers and then instructing them as to the proper rules of safety. Read the manufacturer's guide when available to ensure proper use. In addition, observe the following safety rules:

- Never look directly into the beam. Should beams of higher power than the He-Ne type be used, avoid placing any portion of the body in the beam's path, as the possibility of skin burns increases with beam output power.

- Never look at the reflected beam. Shiney objects that may scatter the beam introduce unnecessary risks to the eyes of both student and teacher. Commonly available welders' goggles may not offer sufficient protection against the reflected beam.

- Block or turn off the beam when not in use.

- Supervise students closely when a laser beam is in use.

- Be sure lasers are properly grounded (three-prong plug) when in use. Under no conditions should a teacher or student remove the external cover while a laser is in operation; the voltages used are lethal.

- Whenever students use a laser beam, insist upon strict adherence to rules of safety. Students wearing corrective lenses may accidentally come into contact with a reflected beam. For example, if a student sitting along a line opposite that of the beam's direction leans into the beam, the near side of one of the lenses may catch the beam and reflect it into the eye.

ELECTRICITY AND ELECTRONIC EQUIPMENT

A common cause of injuries in high school laboratories arise from electrical shock. Opportunities for electrical mishaps abound in physics and physical science laboratories, since either electricity or some type of electrical apparatus is used even in mechanics lab activities. Although contact with any voltage will produce a shock, the current flow determines the effect on the body; the higher the current, the greater the risk of injury. At a let-go current of 10 milliamps (0.01 amp), muscular paralysis sets in; at 100 milliamps, skin burns and ventricular fibrillation occur. A current greater than 200 milliamps (0.2 amp) is fatal. Most voltages that a student would come into contact with are fixed (e.g., 110 volt A.C.). Also, the greater the body's resistance to current, the less likely the possibility of severe injury or death. While the best advice is to never allow the body to come into contact with electricity, this is impractical. Strict adherence to the following rules will greatly reduce the threat of injury.

- Check all electrical equipment before using to see that there are no exposed or frayed wires. Should repair be needed, be sure the piece of equipment is disconnected and consult a qualified person.

- Never handle electrical equipment with wet hands. To do so decreases the body's resistance to current flow thus increasing the risk of severe or fatal shock. Dry skin may have a resistance as high as 500,000 ohms, while wet skin may be as low as 100 ohms. As an added precaution, stand on a dry rubber mat.

- Never permit students to work around electrical equipment without their shoes on.

- Extension cords pose potential problems; refrain from using them if possible.

- Even when disconnected, some electrical equipment can cause shocks. Never allow students to remove the cover of a device without assessing the potential danger.

- All electrical devices should be properly grounded. The three-prong grounded service outlets offer the best protection against shock.

- Hold the plug firmly (not the wire) when inserting or removing it from an electrical outlet. Pulling the wire may result in a short. Broken plugs are easily replaced and should be fixed immediately.

- Locate and label master switches, fuse boxes, or circuit breakers of all outlets servicing the classroom. Be sure that opening the master switches disconnects the power to all lab stations in the classroom.

- When assembling an electrical circuit make the live connection last, that is, attach the ground first then the incoming current wire. When disassembling a circuit remove the wire bringing current to the circuit first. Check all circuits constructed for use in an experiment before allowing students to proceed.

- Do not use multiconnection plugs; circuits can quickly become overloaded.

- Never short circuit a dry cell or storage battery. Wires heat quickly and can cause severe burns.

- Never heat dry or wet cells or throw one into an open flame, an explosion could result and produce severe skin burns. Be sure to discard damaged or old batteries in a receptacle inaccessible to students.

- Be sure the terminals on induction coils are properly labeled.

- Charge capacitors to a voltage that does not exceed their rated value. Polarized capacitors have clearly labeled connecting points.

- Use fuse(s) in student constructed circuits to limit the current when the danger of excessive currents or current fluctuations exist.

- Electronic equipment (especially vacuum tube type) dissipate considerable heat while in use. Be aware that severe burns may result by accidentally touching the outside case. Allow sufficient time for the disconnected piece of equipment to cool before attempting to move it.

- Handle large vacuum tubes (cathode ray or T.V. picture tubes) with extreme caution. While the possibility of implosion is great, there is also the threat of harmful radiation such as ultraviolet, infrared, and X rays. Provide proper insulation or refrain from using equipment capable of producing harmful radiation.

- Read the manufacturer's guidebook before using equipment that you suspect might introduce potential electrical hazards.

- Equipment purchased from Army surplus may not be appropriate for use with high school students. Be fully aware of all potential dangers arising from the use of such equipment. For example, oil capacitors are rated at several kilovolts and when fully charged produce lethal shocks.

X-RAY EQUIPMENT

Registered X-ray equipment should only be operated by persons specially trained in its use. At no time should a science teacher operate or permit students to operate equipment known to produce significant X rays. There are three types of cathode ray tubes commonly used for classroom demonstrations that are capable of producing potentially hazardous X rays; they are:

- Heat effect tube—used to show that cathode rays consist of rapidly moving electrons possessing kinetic energy that can be converted into heat
- Magnetic or deflection effect tube—used to show that cathode rays possess a charge and deflect in the presence of a magnetic field
- Shadow or fluorescence effect tube—used to show that cathode rays (electrons) can cause light to be omitted when colliding with fluorescent material coating the walls of the tube

X rays may be produced whenever the potential difference between anode and cathode is in the 10 kilovolt range (10,000 volts or more), a source of electrons and a target is present, and the tube possesses a good vacuum. When using any of the three tubes as part of a classroom demonstration, be sure to:

- do the demonstration yourself (never permit the student to hold the tube)
- operate the tube at a low current and voltage for only a short period of time
- keep the student at a safe distance (at least eight feet) from the tube

Compliance with these guidelines will greatly reduce the risk of exposure to X rays.

MODEL ROCKETS

At a time when model rocketry is gaining popularity (especially among students in science clubs), it is important that science teachers be aware of both the potential dangers of model rockets as well as the rules of safety for their use. Interest in model rockets affords physical science teachers many opportunities to enrich the study of such topics as energy, energy conservation, forces, and vectors. Considerable risk to the safety of students and teachers is introduced whenever rockets of the homemade variety are used; these must be avoided. Most model rockets purchased from commercial suppliers conform to the regulations stipulated by the Federal Aviation Agency. In any event, check all model rockets against the following guidelines before operation.

- There should be no metal used as a structural part. Wood, plastic, paper, rubber, or similar materials may be used, but under no circumstances is the total mass of the rocket and engine to exceed 453 grams.
- Use only solid propellant reaction engines produced by commercial manufacturers. Follow the manufacturer's directions carefully, using no more than 113 grams of propellant. Never use homemade propellants.
- No rocket is to be fired without a recovery system made from nonflammable wadding. This prevents damage to the rocket as well as ensures the safety of both persons and property on the ground.

- Only launch rockets of proven stability and predictable flight paths.

- Launch through a remotely controlled and electrically operated switch that will return to the off position when launched. The system should have a jet deflector to prevent the engine exhaust from directly hitting the ground. All persons must stand at least six meters from the rocket prior to launching, preferably behind a protective barrier.

- Never launch rockets at an angle less than 60 degrees from the horizon; in high winds; near buildings, powerlines, or tall trees; in the paths of flying aircraft; or under any condition that might endanger either people or property.

- Be sure the launch area is free from flammable materials. The smallest dimension of the ground area should be no less than one-quarter the anticipated maximum altitude the rocket is to be flown.

- Never launch a rocket so that its flight will carry it to a ground target. Similarly, never equip a rocket with an explosive head.

SCIENCE AND HANDICAPPED PERSONS

The term handicap includes such diseases or conditions as speech, hearing, visual, and orthopedic impairments; cerebral palsy; epilepsy; muscular dystrophy; multiple sclerosis; cancer; diabetes; heart disease; mental retardation; emotional illness; and specific learning disabilities such as perceptual handicaps, dyslexia, minimal brain dysfunction, and developmental aphasia.

In accordance with a formal opinion of the Attorney General of the United States, alcoholics and drug addicts are also considered to be handicapped individuals. Physical or mental impairments do not constitute a handicap unless they are severe enough to substantially limit one or more of the major life functions.

The handicapped student necessitates special treatment and consideration in the laboratory classroom. The following general statements will be helpful in working with the handicapped student in the laboratory.

- Be aware of the capabilities of the student. Contact those who could give helpful information to facilitate the handicapped student's training and education. You may consult with local district special service personnel in dealing with specific problems.
- Become knowledgeable about barrier free requirements and make adjustments accordingly.
- Where there is limited mobility or impairment, locate the student as near the exits as possible.
- The handicapped student should be required to perform only those tasks within his or her capabilities.
- The handicapped student should be paired with a student of normal capabilities. Alternates should be designated in the event of absences. Give instructions both audibly and visually, and then have the student repeat the instructions to you so that you can be sure he or she understands. All warning systems should be both visable and audible. Low auxiliary tables (26" to 28" in height) can be utilized when only 36"-high laboratory stations are available.
- Consider the response pattern of handicapped students in modifying the established rules for the laboratory.

Additional information may be obtained from the following documents:

- Section 504 of the Rehabilitation Act of 1973—fact sheet. "Handicapped Persons: Rights under Federal Law." July 1977. Published by U.S. Department of Health, Education, and Welfare, Office of the Secretary, Office for Civil Rights, Washington, DC 20201
- "Science Education for Handicapped Students" (1978). Published by the National Science Teachers Association, 1742 Connecticut Avenue, Washington, DC
- "Building Design Requirements for the Physically Handicapped." Published by the Eastern Paralyzed Veterans Associated, Inc., 423 Park Avenue, South, New York, NY 10016.

- "Specifications for Making Buildings and Facilities Accessible to and Usable by the Physically Handicapped." Bulletin ANSI, A 117.1 - 1961 (R1971).

- "The Texas State Program for Preventing Architectural Barriers." Senate Bill No. 111 - 61 Legislature, State of Texas as amended by HB 1.319 - 62nd Legislature on SB 613 - 63rd Legislature. Published by Texas State Building Commission, P.O. Box 12427, Austin, TX 78711

- You may also contact:
  State Program for Accessibility for the Handicapped
  Texas Board of Control
  P.O. Box 13047
  Austin, TX 78711
  512/475-2622

SAFETY AND FIRST-AID PROCEDURES

Injuries are possible in any classroom; however, they are particularly likely to occur in the science classroom. While prevention is the first and most important safety measure to apply, you, the science teacher, must know what action to take in the event an injury does occur. In most cases, first aid doesn't involve treating the victim but simply preventing further injury until a physician can give treatment. If possible, learn the principles of first aid by taking a first aid course offered by the American Red Cross. In the meantime, the following guidelines will help you handle the injuries most commonly found to occur in a laboratory or on a field trip.

INJURY	WHAT TO DO
Open Cut Or Puncture:	
MINOR—(skin is broken, bleeding is more seeping or oozing)	In a cut from glass, remove any glass fragments, clean by flushing with water then soap and water. Apply a sterile dressing. If in doubt about all glass being removed, seek further medical attention. In other minor lacerations, clean with soap and water then cover with a sterile bandage. Because puncture wounds usually are not naturally flushed out by external bleeding, they are more likely to become infected. Therefore, it is important in a puncture wound to clean thoroughly by a five- to 10-minute soak in soapy water followed by scrubbing, then a dry sterile dressing applied. Here adequate protection from tetanus is also a consideration. Since tetanus grows in the absence of air and in the presence of warmth and moisture, the puncture wound should have medical attention to prevent tetanus.
MAJOR—(more than a seeping or trickle of blood, laceration below the outer skin level)	If bleeding is severe, apply direct pressure with a sterile or clean pad directly over the cut. Keep constant, steady pressure aplied. Additional layers of cloth or dressing may be applied but do not remove the original pressure dressing, even after bleeding is under control. Elevate the limb with the dressing in place under pressure to a point above the victim's heart level to also reduce blood loss. Bandage may be secured firmly or snugly over the wound for transporting to further medical treatment. NOTE: Bleeding can almost always be controlled by direct pressure over the wound. Use of a tourniquet can result in severe damage or loss of a limb and should be used only as a last resort measure to save a life (i.e., an amputated extremity).

Bites And Scratches

MAMMALS—	Allow to bleed briefly. Apply an antiseptic solution and cover with a sterile compress. Take the person to a nurse or physician. Isolate the animal for a minimum of 10 days for observation. Should the animal die during this period, contact the health department for instruction. Refrigerate but do not freeze the body of the animal.
REPTILES—	Determine whether or not the reptile is poisonous. If poisonous, carefully follow the directions in the first aid manual and seek medical attention immediately. If nonpoisonous, treat the bite in the same manner as small mammal bites and scratches. Quarantine and observation of the reptile is recommended in the event the bite or scratch becomes infected.
INSECTS AND SPIDERS—	Determine the type of insect inflicting the wound. Most bites are merely mechanical and should be treated as a small mammal bite (let bleed, apply antiseptic, apply sterile compress). Hypersensitive reactions may result from an insect or spider bite. Should medication for the hypersensitivity be available, apply it according to directions. Should medication not be available, get medical attention as quickly as possible.

Burns:

THERMAL TO SKIN	Application of cold is the best first aid measure. Soaking the burned area in ice water or applying cold towels gives immediate pain relief and restricts local tissue edema and damage. After a 20-minute period if pain is still present, you may repeat the process. Then cover quickly to minimize bacterial contamination and decrease pain further. Sterile dressings are best, but any clean dry cloth can be used in an emergency. Do not apply ointments, creams, or antiseptics to a burn.
BURN TO SKIN	Immediately flush skin with large quantities of running water for at least 10 minutes. Apply stream of water on skin while removing clothing saturated with caustic chemical. Cover burn area with a moist sterile dressing following the washing process. Consult physician.
CLOTHING ON FIRE	Immediately have the victim fall to the floor. Wrap victim in fire blanket and roll on the floor to smother flames. (Standing would force him or her to breathe flames and smoke.) Soak hot clothing with cold water. Do not try to remove charred clothing. Cover victim with a dry blanket to prevent loss of body heat.

Eye Injuries:

BURNS TO EYES	Hold eyelids open and wash eyes with a gentle stream of cool running water. The rubber hose with your emergency supplies can facilitate eye irrigation at any available faucet. A delay of even seconds can greatly increase the extent of a chemical eye burn injury. Continue washing for at least 15 to 20 minutes covering both eyes between washings until further medical instructions or victim is transported to hospital.
FOREIGN BODY IN EYE	Glass or metal fragments should only be removed by a physician. Do not allow victim to rub eyes. This may imbed the fragments. Cover both eyes, even if only one eye is affected, with sterile gauze or eye pads and then a loose bandage. This is necessary to prevent movement of the injured eye. Do not put an ointment of drops in the eye since this will interfere with the doctor's examination. Keep the victim at rest and obtain medical treatment immediately. Transfer the victim on his or her back if at all possible.
DAMAGE TO EYE BODY OR LID	Any damage to the eyeball or eyelid that causes bleeding should have prompt medical attention. No attempt should be made to apply any form of local treatment. Again, cover both eyes with eye pads and transport to a medical facility.
Shock:	Keep victim quiet, covered, and lying down while en route to the hospital. Treat for probable shock in any serious injury (burns, cuts, etc.) by keeping the victim flat, keeping him or her warm and reassured until medical help is obtained.

Take every precaution to eliminate or greatly reduce the risk of personal injury in the science classroom. However, to act swiftly and promptly in the event of an injury, remember the following first-aid and emergency tips:

- Secure the victim from further harm.
- Report the incident to the school authorities.
- All students and teachers must know the location of fire extinguishers, eyewash fountains, safety showers, fire blankets, and first-aid kits.
- All safety equipment must be accessible at all times.
- Fire extinguishers must be recharged or replaced immediately after each use. Unused extinguishers must be inspected at least once a year.
- Use safety signs to identify the location of safety equipment.
- Post emergency instructions concerning fire, explosions, chemical reactions, spillage, and first-aid procedures conspicuously near all storage areas.
- Whenever possible, display current safety posters in science laboratories.

The following list of first-aid supplies is suggested for each science laboratory:

ITEMS		QUANTITY
• Adhesive tape:	one-inch roll	1
	two-inch roll	1
• Sterile gauze squares in two-unit package (four inch by four inch)		12
• Roller gauze bandage, unsterile		
Widths:	two inch	4 to 6
	four inch	4
	six inch	2
• Surgipads eight inch by seven-and-a-half inch or clean, thick cloth padding for compression		4
• Sterile eye pads in single-unit package or sterile gauze squares (two inch by two inch) in two-unit packages		4 to 6
• Assortment of adhesive strips		1 box
• Bandage scissors		1 pair
• Tweezers		1 pair

Be sure to store the supplies in a sturdy container large enough for all supplies to be arranged in an orderly fashion and to be quickly accessible without unpacking the entire contents. Wrap opened supplies so that the unused portions remain clean. Regularly take stock of the contents of the kit and replace used items as needed.

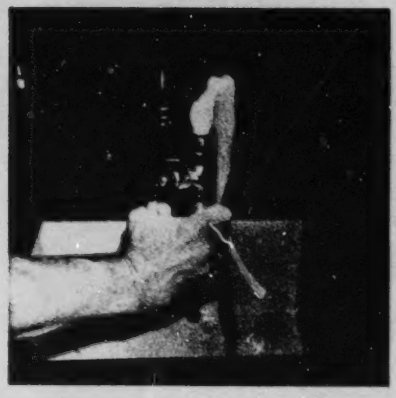
In addition to supplies, the following equipment should be readily accessible to each science laboratory:

- Fire extinguisher (ABC types).* Know location and how to operate.
- Fire blanket. Use to smother fire on clothing and equipment.
- Sandbucket. Use to smother chemical fires.
- Emergency shower facility. Use to flush chemicals off body.
- Safety goggles. Use when working with chemicals.
- Laboratory aprons. Wear to protect clothing.

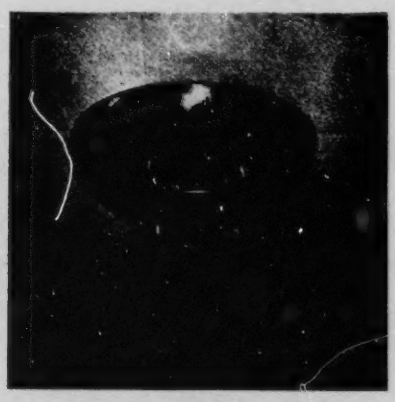
*The multipurpose ABC-type dry chemical fire extinguisher covers all fire classes except those involving reactive and combustible metals such as sodium, lithium, potassium, magnesium, and certain metallic hydrides and alkyds.

- Heat resistant gloves. Use to transfer hot liquids.
- Wire gauze and/or heat-resistant-centered wire gauze. Use for heating containers of liquid.
- Eyewash facilities (see diagram). Use to flush chemicals from eyes.
- Backboard. Use in the event of a back injury. However, DO NOT USE A BACKBOARD UNLESS QUALIFIED MEDICAL PERSONS ARE AVAILABLE; THE STUDENT MAY SUSTAIN PERMANENT NERVE DAMAGE. Should it be necessry to use a backboard follow these steps:
  - Roll the person onto one side.
  - Place backboard beneath the victim.
  - Rotate the victim onto the board.
  - Consult a medical person immediately.
  - Report incident to school authorities.

EMERGENCY EYE AND FACE WASH



Hand-operated eye wash.



Stationary type eye wash.

Combination shower and eye wash in stored position.

Hand-operated shower.

APPENDIX

Appendix A

SAFETY IN THE SCIENCE LABORATORY: A SELF TEST

The following test items have been selected as representative of parts of this publication. Once you have read the publication, take the self test to see how much you have remembered. Some of the items may be appropriate for use on student tests. (See page 54 for answers.)

PART A—General

Directions: Place the letter corresponding to the BEST response in the space provided.

____ 1. To put out a fire involving burning oil or grease, you could use any of the following EXCEPT:

a. foam

b. carbon dioxide

c. water

d. dry chemicals

____ 2. Should acid splash in the eye, which of the following is the correct immediate treatment?

a. Neutralize with a weak solution of sodium bicarbonate, then irrigate with water for five minutes.

b. Irrigate with plenty of water for 15 minutes holding the eyelids open.

c. Wash out using an eye cup and then send victim to a nurse.

____ 3. Which of the following is NOT an acceptable practice when making up acid solutions?

a. Pour acids over the sink so spills won't contaminate desk area.

b. Slowly add water to acid and stir continuously.

c. Rinse off acid bottle after pouring so that no trickles of acid remain on the outside of the bottle.

d. Flush acid spill with lots of water, use rags or paper towels to absorb it, and then dispose of the rags.

____ 4. When cleaning up after a lab, remember to do all of the following EXCEPT:

a. Dispose of solids in the proper jar or crock and not in the sink.

b. Pour soluble waste solutions in water into the drain and flush with plenty of water.

c. Clean glassware immediately after use and rinse with distilled water.

d. Pour flammable liquids into a specially marked container that has a top on it.

e. Allow mercury spills to vaporize if the mercury gets into an inaccessible place.

____ 5. Which of the following is NOT proper procedure when heating materials in the lab?

a. When using an open flame or heating apparatus, remain in the vicinity of the experiment.

b. When heating solids and liquids in a test tube with an open flame, tilt the tube slightly and move it in and out of the flame.

c. Heat directly the bottom of the tube.

d. Be sure there are no cracks in a beaker to be heated and that the outside is dry.

____ 6. Of the following, which one should be used to put out a fire involving an alkali metal, such as sodium or potassium?

a. water

b. carbon dioxide fire extinguisher

c. soda-acid fire extinguisher

d. dry sand

____ 7. When should you use the safety shower?

a. When a large amount of acid spills on you

b. If your clothes catch fire

c. When a large amount of base spills on you

d. All of the above

e. Just a and c

____ 8. Were you to cut your finger while working in the lab you should:

a. Not worry about it if it is not bleeding too much.

b. Seek medical first aid from a qualified person.

c. Wrap a wet paper towel around the cut and continue working.

d. Go to the first-aid kit yourself and place antiseptic on it.

___ 9. Should your clothes catch fire in the lab, all of the following procedures would be effective EXCEPT:

a. Use your lab apron to smother flames.

b. Use the safety shower.

c. Roll on the floor to smother the flames.

d. Use the fire blanket.

e. Have someone spray you with a soda-acid fire extinguisher.

___ 10. Which of the following is NOT proper procedure when using electrical equipment?

a. Be sure to unplug apparatus before making adjustments on it or fixing bad wires.

b. Make sure your lab area, equipment, and your hands are dry before using electrical equipment.

c. Check electrical cords for worn areas and bad insulation before using them.

d. Take the piece of equipment apart if it fails to operate.

PART B—Life Science

Directions: Place the letter corresponding to the BEST response in the space provided.

___ 1. Animal experimentation and care requirements are governed by:

a. local board policy

b. state regulations

c. federal regulations

d. all of the above

___ 2. Which of the following animals are thought to be carriers of salmonella?

a. snakes

b. turtles

c. toads

d. all of the above

____ 3. The period of observation for a suspected rabid animal is:

a. three days

b. five days

c. seven days

d. 10 days

____ 4. If an animal bite occurs and the animal dies, which of the following should NOT be done?

a. call the health department

b. contact the victim's parents

c. freeze the animal

d. inform the building administrator

____ 5. The proper way to instruct in the handling of animals is to:

a. demonstrate proper procedure

b. let students learn by themselves

c. let knowledgeable students instruct others under supervision of teacher

d. both a and c

____ 6. Special precautions are required whenever persons are bitten by:

a. snakes

b. lizards

c. gerbils

d. all of the above

____ 7. Most plants that teachers use in the classroom are safe to:

a. observe

b. touch

c. taste

d. burn

____ 8. To ensure that field trips are maximally effective, the teacher should do all of the following EXCEPT:

a. carefully plan the trip

b. involve teachers and parents as sponsors

c. send students to scout the area

d. inform students of potential dangers

____ 9. The best rule of thumb to use when handling protozoan cultures is to handle them as though they:

a. are edible

b. present no hazards

c. may be pathogenic

d. are not pathogenic

____ 10. When using live animals in experiments in the classroom, which of the following types of studies are acceptable?

a. starvation

b. observation

c. disease

d. surgical

PART C—Physical Science

Directions: Place the letter corresponding to the best response in the space provided.

____ 1. A common cause of injuries in high school laboratories arises from:

a. workshop hazards

b. electrical shock

c. radioactive material and radiation burns

d. laser burns

e. poisons

____ 2. The one-hand rule should be strictly enforced should it become absolutely necessary to work on a live chassis (such as a radio in an electronics lab). This rule stresses the importance of:

a. keeping one hand free at all times to securely hold the electrical device when using a test probe

b. using either your right hand (if right-handed) or your left hand (if left-handed) to manipulate a test probe in an open chassis but never both

c. placing one hand on the switch controlling power to the chassis should the current need to be immediately shut off while using a test probe

d. putting one hand in your pocket or behind your back when using a test probe

____ 3. Muscular paralysis sets in at a "let-go" current (60 Hz/100 V) of approximately:

a. 1 ma

b. 10 ma

c. 100 ma

d. 1 000 ma

____ 4. Skin burns and ventricular fibrillation occur when current flow in the body approaches:

a. 10 ma

b. 100 ma

c. 200 ma

d. 1 000 ma

____ 5. Most of the resistance to current flow is in the skin; this can vary from approximately 100 ohms for wet skin to _____ for dry skin.

a. 500 ohms

b. 5 000 ohms

c. 50 000 ohms

d. 500 000 ohms

___ 6. X rays are produced when electrons are accelerated in a vacuum through a sufficiently high potential difference; this minimum voltage is of the order of:

a. 100 volts

b. 1 000 volts

c. 10 000 volts

d. 100 000 volts

___ 7. The type of goggles commonly worn by welders is least effective when viewing light emitted by:

a. lasers

b. carbon arc lamps

c. sodium vapor lamps

d. mercury - quartz lamps

___ 8. About how much time is required under direct viewing of a He-Ne laser (1 mW) before sufficient energy is deposited to cause retinal damage?

a. 1 sec

b. 0.1 sec

c. 0.01 sec

d. 0.001 sec

___ 9. Hazards exist whenever students use lasers in the physics laboratory; possible damage could arise as a result of:

a. looking into the beam

b. looking at the scattered beam

c. looking along a line opposite the beam

d. both a and b

e. a, b, and c

____ 10. Of the following poisons commonly available in the physics laboratory, which one is a known carcinogen?

a. metallic mercury

b. beryllium phosphors (in fluorescent tubes)

c. copper sulphate and acids (electrolysis)

d. acetone

e. carbon tetrachloride

Answers: (Part A) 1.c 2.b 3.b 4.e 5.c 6.d 7.e. 8.b 9.e 10.d

(Part B) 1.d 2.b 3.d 4.c 5.d 6.d 7.a 8.c 9.c 10.b

(Part C) 1.b 2.d 3.b 4.b 5.d 6.c 7.a 8.c 9.e 10.d

Appendix B

SAFETY SYMBOLS FOR THE SCIENCE LABORATORY

Each of the following symbols corresponds to a specific warning and may be found within one of two different geometric shapes. An octagon indicates danger, and a square indicates recommended use. Duplicate and cut out the symbol(s) you need for the activity your students will perform. Affix the symbol to the activity sheet in the appropriate location. Make a thermal ditto of the activity sheet, duplicate the required number of copies, and distribute copies to your students. By using safety symbols and by discussing in advance potential hazards of the activity, you increase the likelihood that students will be conscious of safe laboratory procedures.

See pages 57-62 for geometric shapes and symbols for teachers' use. You may want to display the shapes and symbols (with their meanings) in the lab. In addition, transparencies can be easily made from these masters. Students should be able to recall the meanings of the shapes and symbols at all times.

Symbols on this page taken from article by Jones, Hudson C., and Llewellyn, Gerald C., "Sign Language for Safety," The Science Teacher, Vol. 44, No. 9, December 1977, National Science Teachers Association, 1742 Connecticut Avenue, N.W., Washington, DC 20009

DANGER SYMBOLS

Poison*

Poison

Biohazard

Radiation

Caustic or Corrosive

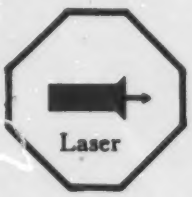
Electric Hazard

Loud Noise

Sharp Object

Noxious Fumes

Microwave



Laser

Steam

Bee

Insect or Spider

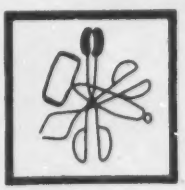
Snake

SYMBOLS FOR RECOMMENDED USE

Lab Coat

Glasses

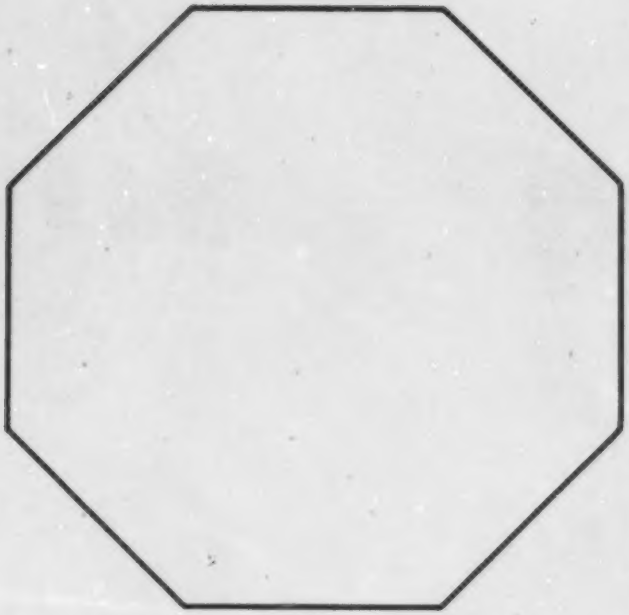
Pipette Bulb

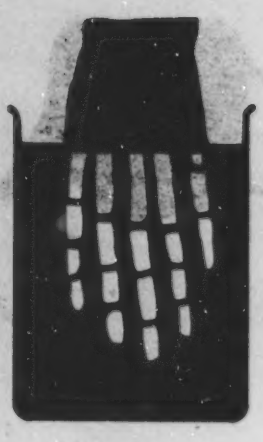


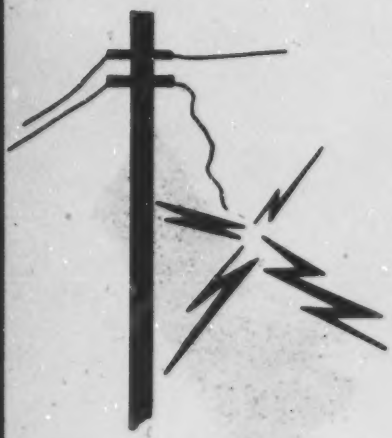
Tongs

Gloves

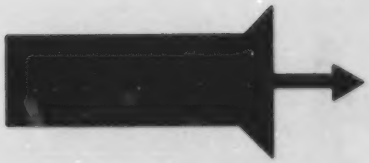
*Effective with young students.







MICROWAVE



LASER

Appendix C

LABORATORY SAFETY CHECKLIST

Check all physical facilities annually using the following checklist. File a copy of the checklist with the building principal and take prompt action to correct any unsafe conditions and practices so that maximum safety is ensured at all times.

Notify in writing the principal and department chairperson of the existence of any hazard.

Section I: LABORATORY-CLASSROOM

Safety Factor	Yes	No	NA
Laboratory has two exits.	___	___	___
The emergency exit procedure is posted.	___	___	___
A general alarm system is provided for the entire building.	___	___	___
Individual student work stations are provided (number of students does not exceed the number of work stations).	___	___	___
Work surfaces are made of nonporous and chemical-resistant materials.	___	___	___
Safety rules are posted in the laboratory.	___	___	___
A master water cut-off valve is conveniently located.	___	___	___
A master electricity cut-off switch is conveniently located.	___	___	___
A master gas cut-off valve is conveniently located.	___	___	___
Aisles are wide enough so that teachers and students can move freely without interfering with others' work.	___	___	___
A key is provided to lock the laboratory-classroom when not in use.	___	___	___
Separate storage area is provided for large containers of dangerous reagents; e.g., five-liter bottles of concentrated acid.	___	___	___
An adequate room ventilation system is provided in all laboratories using volatile substances.	___	___	___
Household type refrigerators are not used for chemical storage.	___	___	___
A safety shower is available in all chemistry laboratories.	___	___	___

Facilities for flushing the eyes are available.	___	___	___
Proper types of fire extinguishers are accessible.	___	___	___
Rubber or plastic gloves are availab[illegible] for student use.	___	___	___
Approved eye protection devices are available for each student.	___	___	___
Approved respiratory protection devices are provided to filter dust and organic vapor.	___	___	___
Approved laboratory aprons are available for each student.	___	___	___
Approved fire blankets are available in each laboratory.	___	___	___
Sand buckets are available in each laboratory.	___	___	___
Heat resistant gloves are available for student use.	___	___	___
Operational fume hoods are provided in laboratories where noxious or toxic chemical fumes are used.	___	___	___
Fume hoods have operational safety-glass access windows.	___	___	___
Fume hood is clear and clean (not used as a storage area).	___	___	___
Earthenware waste jars are provided in each laboratory.	___	___	___
Floor is clear of refuse and equipment.	___	___	___
No refuse is left in laboratory overnight.	___	___	___
A container of an acid neutralizer is available in chemistry laboratories.	___	___	___
All electrical outlets provide a grounded connection.	___	___	___
All electrical equipment and appliances are properly grounded.	___	___	___
Sufficient, properly installed electrical outlets are provided so as to eliminate the use of extension cords.	___	___	___

Section II: STOREROOM

Safety Factor	Yes	No	NA
The storeroom is well lighted, has no blind alleys, and is forced-ventilated.	___	___	___
There is adequate space in the storeroom to provide storage for all chemicals and supplies.	___	___	___
All reagent chemicals are labeled.	___	___	___
All unlabeled reagents are disposed of properly.	___	___	___
Chemicals such as oxidizing and reducing agents that might react together are stored separately.	___	___	___
Volatile liquids are stored far away from heat sources and electrical switches.	___	___	___
Dangerous chemicals used in the laboratory are kept in small quantities.	___	___	___
Old and deteriorating chemicals are to be disposed of properly.	___	___	___
All acids and other corrosive materials are stored on or near the floor.	___	___	___
Large containers of chemicals are stored near the floor.	___	___	___
An appropriate fire extinguisher is located in each storeroom.	___	___	___
Protective gloves are available for transferring hazardous chemicals.	___	___	___
Different storage areas are provided to separate chemicals from delicate equipment; e.g., meters, microscopes.	___	___	___
Metal shelf supports are inspected frequently for signs of chemical corrosion.	___	___	___
A cart is provided to transport materials from storeroom to laboratory.	___	___	___
A horizontal bin near the floor is supplied to store glass tubing.	___	___	___

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For additional information concerning safety, contact:

Division of Occupational Safety and State Safety Engineer
Texas Occupational Safety Board
1100 West 49th Street
Austin, TX 78756

DISTRICT OFFICES:
Arlington
Dallas
Houston
San Antonio
Midland
Tyler

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 WAGE-HOUR LAW AMENDMENTS; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED

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